BY APPOINTMENT TO
H.M. THE KING

INSTRUCTION BOOK

FOR

DENNIS

Patent Turbine Motor
FIRE ENGINES

350/450 & 650/800 GALLON
LOW-LOAD MODELS

DENNIS BROS., LTD., GUILDFORD
Motor Vehicle Manufacturers to H.M. The King

Publication No. 748

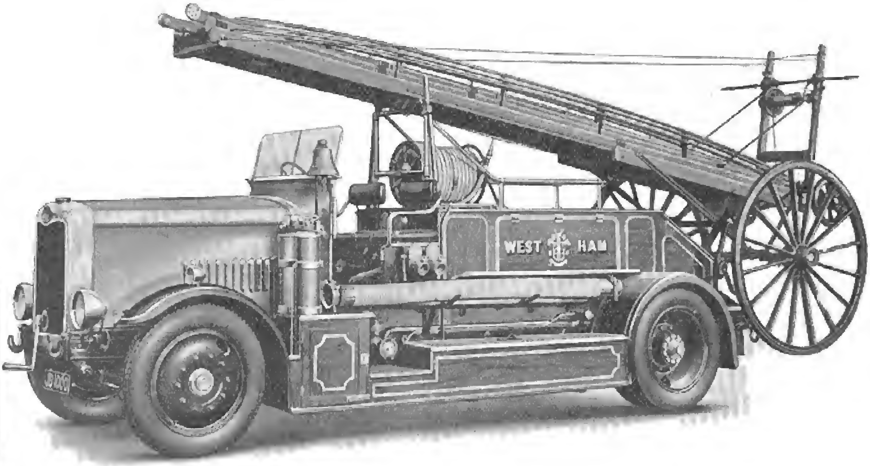
Instructions for Management and Control of

350/450 Gall. and 650/800 Gall.

DENNIS

Patent Turbine

MOTOR FIRE ENGINES



650/800 Gallon, 90/100 h.p., 6-cylinder Dennis Fire Engine with forward pump.

DENNIS BROS. LTD.
— GUILDFORD —

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INTRODUCTION

Our Aim These few hints are given with a view to helping the users and drivers of Dennis FIRE ENGINES.

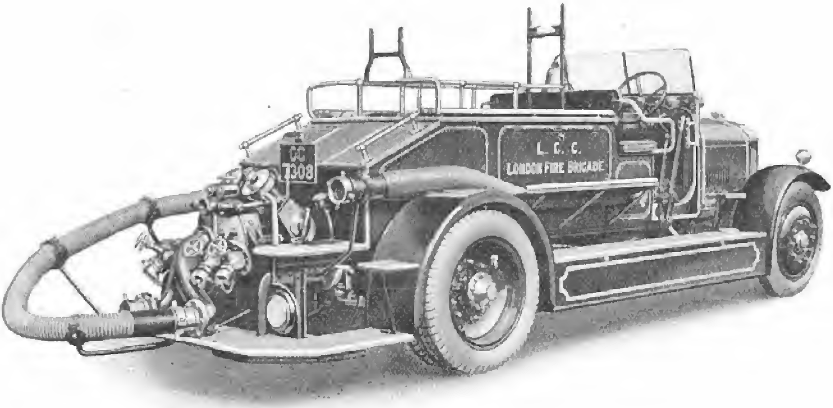
We wish to point out, however, that in a treatise of this description it is practically impossible to cover all the points and difficulties that may arise while operating any motor vehicle, but the intelligent driver who wishes to take an interest in his vehicle and obtain the best results therefrom will, we hope, find the descriptions and diagrams of considerable service.

When the information does not meet any special case, we shall welcome applications for advice or assistance, which we shall at all times be glad to render.

Importance of Lubrication We think it worth while mentioning here that one of the most important details contributing towards success in running a Motor Vehicle is that of paying **strict attention to Lubrication.** In addition to seeing that the Engine, Gearbox, Axle, and other parts are well supplied according to the instructions in the subsequent pages, we would draw attention to the necessity of going round with an oilcan and oiling every brake connection, etc. ; in fact, every place where movement occurs ; also of keeping the exposed threads for the adjustment of brakes, etc., oiled. This will help greatly when the adjustment has to be made. It is a good thing to add about half paraffin to the oil in the can, as this will help the oil to penetrate should rust be present. We look upon these instructions with regard to oiling the detail parts of a Motor Chassis, in addition to the main units, as MOST IMPORTANT. Proper Lubrication will do a lot towards preventing brake connections, steering tie-rods, etc., getting into a loose, noisy condition.

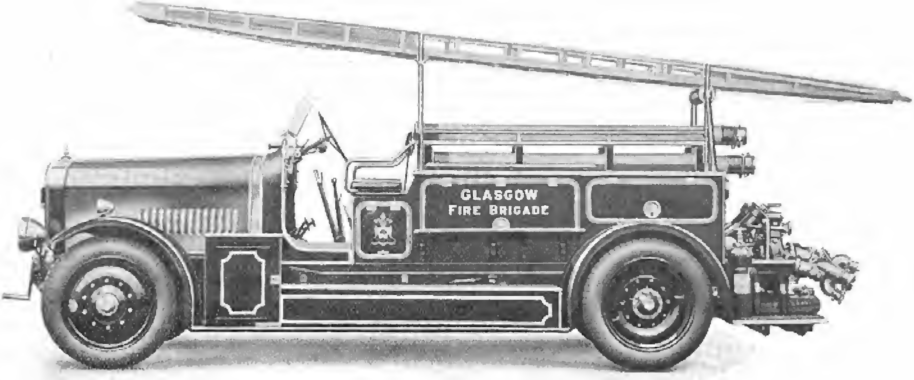
Overhauls Another very important advantage in keeping the Chassis well oiled "**all over**" is that when adjustments and replacements have to be made, the parts come to pieces with half the trouble that would be the case where brake shafts, shackle pins, etc., have been allowed to rust up tight.

Study your Vehicle Every driver should take a studied interest in the running of the vehicle under his control. In this way he will learn to recognize when any detail requires attention. Then, by seeing to the job at once, the consequent evils of a neglected repair or adjustment will be avoided.



350/450 Gallon Dennis Patent Turbine Fire Engine

175 Dennis Fire Engines have been supplied to the London Fire Brigade alone.



650/800 Gallon, 6-cylinder Dennis Low-Load Fire Engine
with pump at rear.

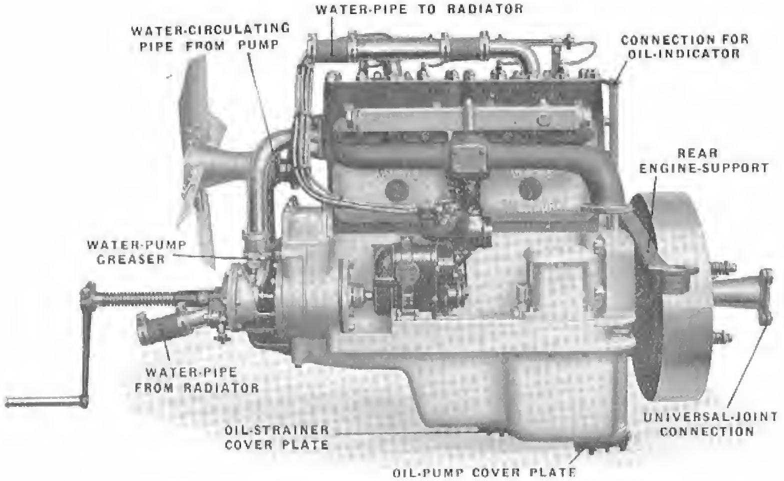


Fig. 1.—Near-side View of 4-cylinder Engine, complete, as fitted to 350/450 Gallon Fire Engines.

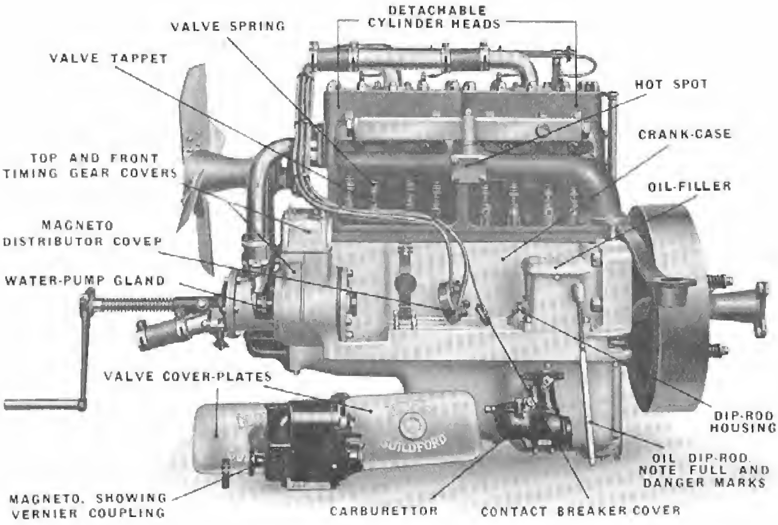

DETACHABLE CYLINDER HEADS
VALVE SPRING
VALVE TAPPET
HOT SPOT
CRANK-CASE
TOP AND FRONT TIMING GEAR COVERS
OIL-FILLER
MAGNETO DISTRIBUTOR COVER
WATER-PUMP GLAND
VALVE COVER-PLATES
DIP-ROD HOUSING
OIL DIP-ROD. NOTE FULL AND DANGER MARKS
MAGNETO, SHOWING VERNIER COUPLING
CARBURETTOR
CONTACT BREAKER COVER
GUILDFORD

Fig. 2.—The same view as above, but showing Magneto, Carburettor, Valve Cover Plates and Dip-rod removed.

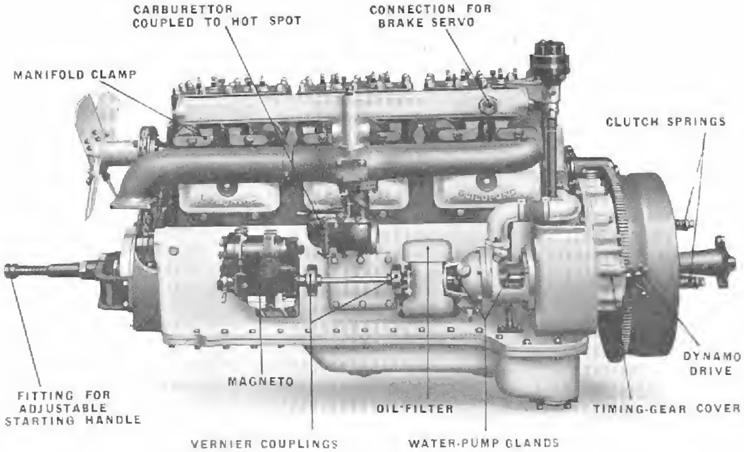


Fig. 3.—Near side of 6-cylinder Engine, complete, as fitted to 650/800 Gallon Fire Engine.

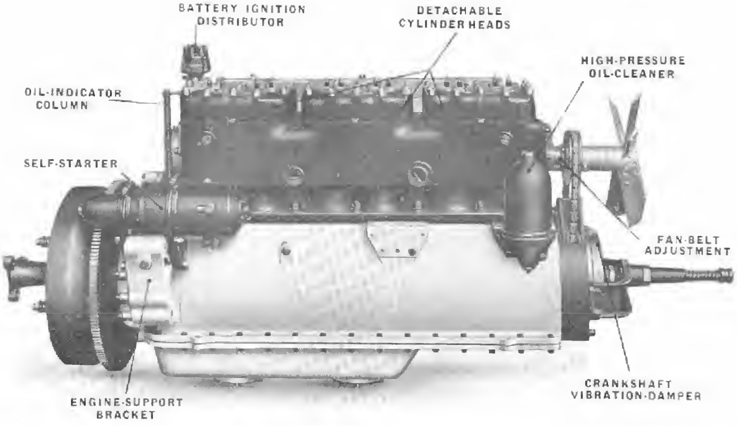

BATTERY IGNITION DISTRIBUTOR
DETACHABLE CYLINDER HEADS
HIGH-PRESSURE OIL-CLEANER
OIL-INDICATOR COLUMN
SELF-STARTER
FAN-BELT ADJUSTMENT
CRANKSHAFT VIBRATION-DAMPER
ENGINE-SUPPORT BRACKET

Fig. 4.—Off side of 6-cylinder Engine, complete, as fitted to 650/800 Gallon Fire Engine.

Valve Setting

The correct setting of Valves of the two power units embodied in the Dennis Fire Engines with which this handbook deals, is as set out below. Measurements are to be taken on piston travel.

Valve Setting of our 650/800 Gallon Fire Engine.

Exhaust opens	17 mm. before bottom.
Exhaust shuts	3 mm. after top.
Inlet opens	1·5 mm. before top.
Inlet shuts	20·5 mm. after bottom.

Valve Setting of our 350/450 Gallon Fire Engine.

Exhaust opens	17·5 mm. before bottom.
Exhaust shuts	3 mm. after top.
Inlet opens	1·5 mm. before top.
Inlet shuts	21·5 mm. after bottom.

Tappet clearance ·010 ins. in all cases.

Circulating Pump

Leakage from Pump In the event of a leakage, the packing gland nut should be tightened approximately *one-half* to *one whole turn*, by insertion of the small tommy bar. It is unwise and unnecessary to tighten this gland excessively, or overheating and undue wear will result. To obviate rust and to permit of replacement rendered necessary by wear through excessive tightening of the gland nut, the water pump spindle is fitted with a pressed-on stainless steel sleeve, 2 in. in length, which may at any time be renewed.

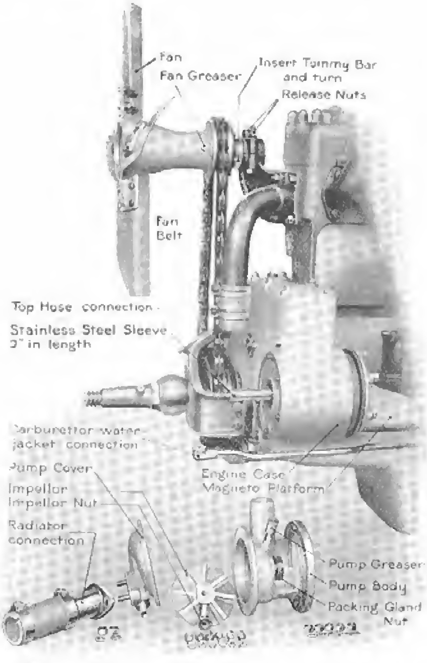


Fig. 5.—Showing Fan Belt Adjustment and Pump Assembly (350/450 Gallon Engine).

Re-packing New packing may be inserted, if required, after slacking away the packing gland nut fully, without removing the water-pump. *Special metallic packing* obtainable from the Works is recommended for this purpose. Alternatively three 3½ in. lengths of 5-16 in. square asbestos, well steeped in tallow, are necessary; they should be inserted in the gland housing, with the joints spaced at intervals of 120 degrees, to prevent leakage.

Detaching Should it at any time become necessary to detach the water pump as a whole the following is the procedure:—(1) drain system, (2) disconnect the bottom radiator connection and top hose pipe, (3) take off the pump cover, impellor nut and impellor, (4) ease back the magneto platform complete with magneto, as shown in the illustration, ¾ in.—not more, lest the timing be disarranged. This will permit of the pump driving spindle being withdrawn sufficiently for the pump body to be taken away.

Engine Lubrication

The oiling system described relates to the 350/450 gallon models, but applies, with slight modification, to the 650/800 gallon model.

Selection of Lubricant Undoubtedly the most important feature in connection with the upkeep and smooth running of an engine is an efficient lubricating system, together with a good quality oil.

The following table of oils indicates suitable grades for use in the summer and winter respectively, and operators are strongly advised to see that the changes are duly made.

Name	*Dick*	*Duckham*	*Pratt*	*Price*	*Shell*	*Texaco*	*Vacuum*	*Wakefield*
SUMMER	C II.O	NP3	Heavy	Olympia Y	Triple Shell	Golden Heavy	Mobiloil BB	Castrol C
WINTER	B II.O	NP2	Medium Heavy	Olympia Y	Double Shell	Golden Heavy	Mobiloil A	Castrol AA

If possible the engine and radiator should be kept warm at all times by some form of supplementary heater, such as the electric immersion type, or by suitable connections to the station heating apparatus. Either method is preferable to the usual practice of running the engine periodically.

Dip-Rod We strongly advise that the oil-level should not be allowed to fall more than half-way from the "FULL" to the "DANGER" mark.

Remember When starting up an engine from cold, it is not advisable to accelerate immediately; the engine should be permitted to run slowly for a few minutes for the oil to be distributed.

Engine Lubricating System The system is entirely automatic, and does not require priming. The oil is poured into the engine through the filler, and passes immediately to the sump on base of engine, passing through a fine gauze strainer, removable from engine sump, before reaching the circulating pump.

Oil-Circulating Pump The Pump, which is of the rotary gear-driven type, is situated at the rear of the sump, and is fully submerged. It is driven by skew gearing from the rear end of the camshaft, and is readily detachable by removing six nuts on its flanged base. When replacing, see that jaw-coupling engages and pump pushes into position by hand, before tightening nuts; turning the crankshaft slowly will facilitate engagement.

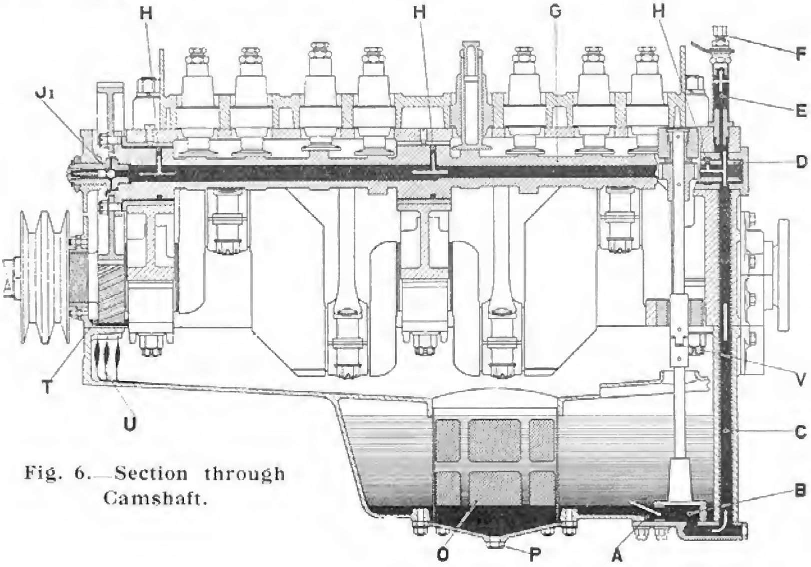


Fig. 6.—Section through Camshaft.

Engine Lubrication—*continued*

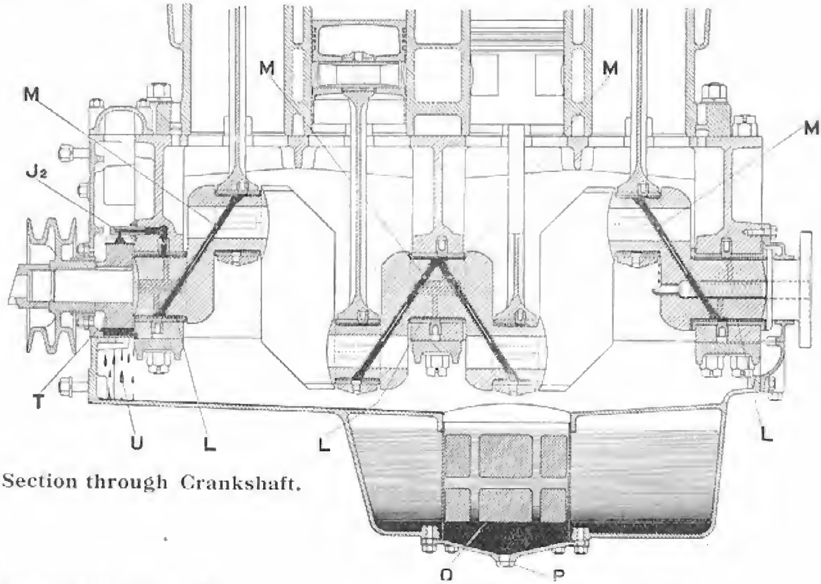


Fig. 7.—Section through Crankshaft.

Key to Oiling System.

A. Oil passage to pump.
B. Pump.
C. Passage to hollow camshaft.
D. End of hollow camshaft.
E. Oil indicator column.
F. Connection for oil indicator.
G. Hollow camshaft.
H. Oil passages from camshaft to front, centre and rear main crankshaft bearings.
J1. Oil release valve on 4-cyl. engine. (On 6-cyl. engine, placed in valve-chest.)
J2. Oil release from front crankshaft bearing to timing gear. (On 6-cyl. engine, placed at rear.)
K. Oil filler cap.
L. Crankshaft bearing.
M. Oil passage from crankshaft bearings to connecting rod big end bearings.
O. Oil filter. (Duplicated on 6-cyl. engine.)
P. Drain plug. (Duplicated on 6-cyl. engine.)
Q. Dip rod.
R. Full position.
S. Danger mark.
T. Timing gear lubricant.
U. Oil return to crank case.
V. Oil pump coupling.

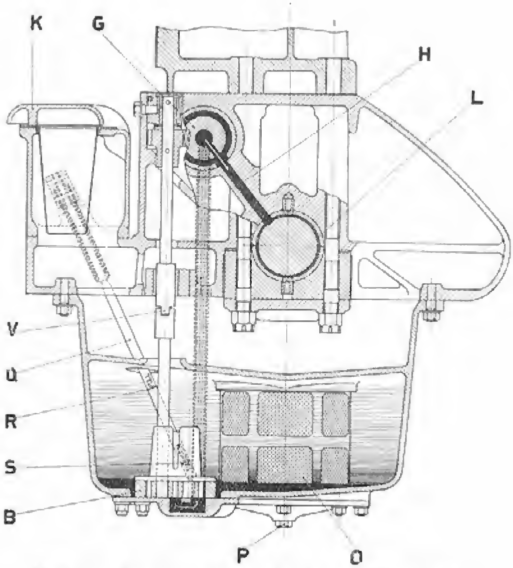


Fig. 8.—Section through Centre Bearing.

Care of Clutch

External Cone-Type This clutch is of the composition-lined cone type. A careful study of the illustration will indicate method of operation.

It is most important to see that this detail is kept in proper working order. On the pedal being pressed hard down, the clutch cone should soon come to rest, to allow the gears to mesh quietly. **A Clutch-Stop** is provided for this purpose, and should be kept adjusted to its work. The clutch should be kept clean and all working parts well lubricated.

Do not drive with a fierce clutch, but tone it down at once with a little oil, or, preferably, graphite and grease.

Should the clutch show signs of slipping, wash it out with paraffin and see that the adjustment of the pedal is not preventing the male portion from going " home " into its position. This is a frequent cause of **Slipping Clutch,** for as the composition face wears, so the clutch goes farther into its cone ; therefore the connection link between pedal and clutch shaft must be lengthened for the pedal to retain its normal position.

When all pressure is removed from the clutch pedal, there should be a little " play " in the connections ; that is, it should be possible to pull the pedal up from the footboards about one-quarter of an inch. **This will mean that the Pedal Connection will not be interfering with the Proper Engagement of the Clutch.**

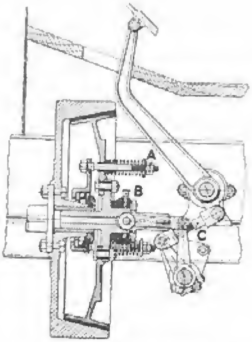


Fig. 9.—Arrangement of Cone Clutch and Withdrawal Mechanism.

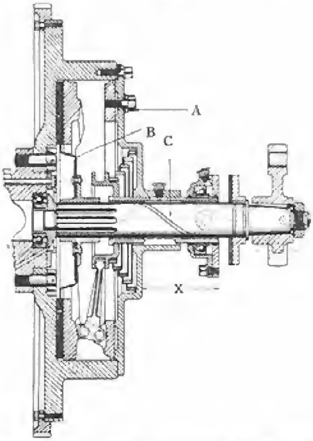


Fig. 10.—A sectional view of the single-plate clutch. A, set-screws for adjustment. B, clutch-plate. C, clutch-shaft.

The outside spring adjustment may require attention, and a little more pressure can be put on the clutch faces by tightening the three nuts on the ends of the spring studs, taking care to **Adjust all Three alike** as regards number of turns.

Plate-Clutch This clutch, shown in the accompanying illustration, is adjustable by means of the three outside set-screws (A) in the face of the clutch.

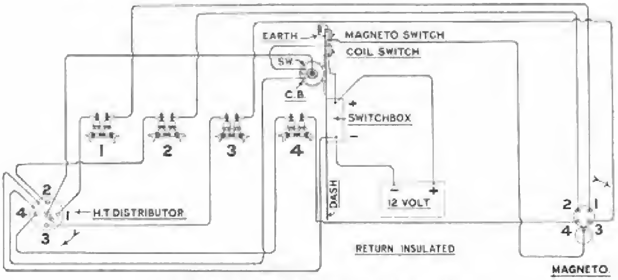
If the clutch shows signs of slip, these screws should be slacked back slightly, (do not take them out) and moved to the right—*i.e.*, clockwise—within the slots. The pedal should be pushed down to allow this adjustment to be carried out. Very little movement will tighten the clutch considerably.

While this is being done, care should be taken to ensure that the distance (X) between the face-plate of the clutch, and the face of metallic stop is $4\frac{5}{16}''$ in the case of the 4-cylinder engine, and $3\frac{3}{4}''$ in the case of the 6-cylinder.

Lighting and Starting System

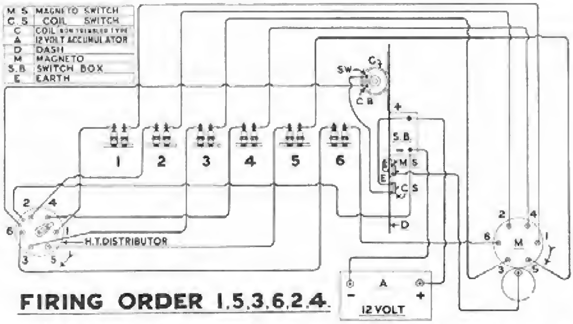
This consists of a standard C.A.V. 12-volt dynamo set, which comprises the following details :— A 12-volt dynamo, driven by the engine ; a switchboard and cut-out ; a 50-ampere hour accumulator ; electric self-starter ; two head lamps, two side lamps, tail lamp and heel-board lamp, together with all necessary wiring. Unless the machine gets a fair amount of running and a pumping job occasionally, it will be found impossible to keep the accumulator fully charged without its being occasionally put on a charging board. This specially applies if the electric self-starter is used unduly, and consequently, it is very desirable that it should only be used when actually responding to a fire-call. At other times, use the starting-handle.

Ignition Wiring Diagrams



FIRING ORDER 1 . 3 . 4 . 2

Fig. 11.—Magneto and Accumulator Ignition Wiring (350/450 gall. Fire Engine).



FIRING ORDER 1.5.3.6.2.4.

1-4-2-6-3-5

Fig. 12.—Magneto and Accumulator Ignition Wiring (650/800 gall. Fire Engine).

On the large type fire engines, we make a point of always fitting two separate ignitions, which consist of a high-tension magneto, and a 12-volt coil working through a distributor ; two sets of plugs are fitted.

Timing Magneto If it has been necessary to dismantle the magneto drive, it will require to be readjusted so that the contact-points separate when the piston is at the top dead centre with the rocker at full retard. Before reassembling, the engine should be turned until No. 1 piston is at the top dead centre. Then turn the armature of the magneto so that the carbon brush is entering No. 1 segment and the platinum points just break. A very fine adjustment can be made by the vernier coupling driving the magneto.

Care of the Magneto and Ignition System

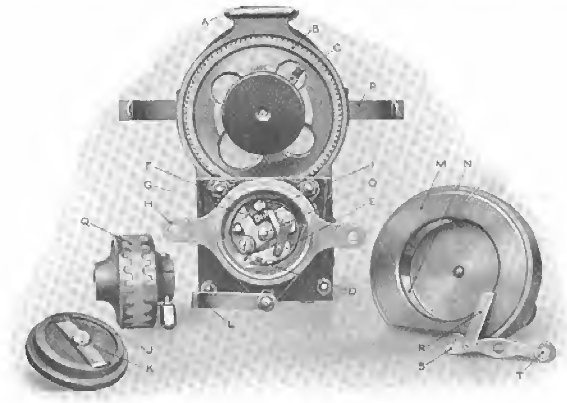


Fig. 13.—The Magneto, with Contact-Breaker and Distributor Covers Removed.

A. Oil Cap.
B. Distributor Gear Wheel.
C. Distributor Brush Holder.
D. Fibre Cam in Bell Crank.
E. Bell Crank.
F. Platinum Contact Screw.
G. Adjustable Contact Screw.
H. Timing Lever.
I. Steel Cam Ring.
J. Contact-Breaker Dust Cover.
K. Switch Wire Connection.
L. Dust Cover Clip.
M. Distributor.
N. Distributor Contact Segments.
O. Contact-Breaker Fixing Screw
P. Distributor Cover Clips.
Q. Simms' Vernier Coupling.
R. Gap Gauge for Contact Screws.
S. Spanner for Contact Screws.
T. Spanner for Fixing Screw "O"

Lubrication The armature of the magneto is fitted at both ends with ball bearings which require only very little lubrication. Excessive oiling should be carefully avoided. Nothing but the best oil should be used, not too thin, and the magneto should be lubricated at regular intervals. The distributor gear wheel is provided with a plain bearing which is oiled by means of a felt wick, and requires, of course, more lubrication than the ball bearings of the armature.

It is of the utmost importance that no oil shall get on the platinum surfaces of the contact-breaker, oil being a non-conductor, and so tending to insulate the platinum contacts from each other, and causing excessive burning on the points.

The Switch When the switch is closed or in " OFF " position, the primary winding is short-circuited, as a result of the terminal screw being " Earthed " ; that is to say, in contact with the frame. This renders the action of the contact-breaker ineffective.

Contact-Breaker The most delicate part of the magneto is the contact-breaker. It is advisable to inspect it occasionally, and to do this it is only necessary to remove the fibre disc, which is held on to the timing lever by a spring. The contact-breaker is then accessible for examination, and, if necessary, the gap between the platinum points can be adjusted. When these contacts are separated by the fibre block of the bell crank lever striking the steel cams fitted in the timing ring, the platinum contacts must not be more than

Care of the Magneto and Ignition System—*continued*

0·4 mm. (about $\frac{1}{64}$th of an inch) apart. This distance can be regulated by means of the adjustment provided on the platinum screw. If the points should be uneven, **but only then,** they should be filed flat with a smooth file, and subsequently adjusted.

Special attention should be given to the easy movement of the bell crank lever, the pivot of which works in a fibre bush in order to render lubrication unnecessary. On new magnetos it may happen occasionally that this bell crank lever becomes stuck up owing to the swelling of the fibre, but by slightly increasing the bore of the fibre bush by means of a reamer, this defect can easily be remedied.

If, after carrying out the foregoing instructions, the running of the motor is not satisfactory, the timing of the magneto should be verified.

If the timing of the magneto is found to be correct, but ignition is still unsatisfactory, it is advisable to return the magneto at once to the makers as any further dismantling of it would probably result in the eventual repair being more complicated and more expensive. Apart from this, the makers can only guarantee magnetos whose adjustment has not exceeded the instructions given in this booklet.

Misfiring If any cylinder misfire continually, the trouble will probably be due to the sparking plug or high-tension lead, the changing of which will prove an immediate remedy. The usual troubles experienced with sparking plugs can be dealt with as follows :—

Care of Sparking Plugs 1. Short circuiting between the electrodes and the body of the plug, caused by small metallic beads which are sometimes formed as a result of the strong magneto spark melting the electrode.

This fault can be quickly remedied, as the beads are easily removed.

2. Too wide a gap between the electrodes and the body of the plug. The correct gap is 0·5 to 0·6 mm. (about $\frac{1}{50}$ of an inch), and anything much larger or less than this will tend to make the ignition work unsatisfactorily. The electrodes can easily be bent until they are the correct distance from the body of the plug. If the gap is much too great, the spark produced by the magneto will be discharged across the safety gap. When plugs are removed from the cylinders, they might appear, of course, to work satisfactorily even if the gaps are excessive, but it must be remembered that they will not necessarily work correctly under compression where the resistance to the spark is very much greater than in free air. The fact that the sparks jump regularly across the plugs, when the latter are removed from the cylinders, gives no guarantee that the electrodes are set correctly.

3. Sooting up of the plugs. If sooting up should occur, the portions which are exposed to the explosive gases can easily be cleaned by means of a little petrol.

If the ignition fails completely and suddenly, it may be concluded that the connection for short-circuiting the magneto is faulty and a short circuit is being accidentally caused. This can easily be ascertained by removing the switch cable from the magneto terminal, but if this does not remedy the trouble, the cause must be sought elsewhere.

Accumulator Ignition A single coil with a high-tension distributor. This should be treated in the same way as the magneto with the exception that the make-and-break will require more attention and should be inspected every two or three months and adjusted if necessary. The same gauge should be used as for the break in the

Care of Magneto and Ignition System—*continued*

magneto, about 0·5 mm. When re-timing this system, the contact-points should separate when the piston is at top dead centre on the compression stroke, and the ignition lever is advanced about a quarter of its travel.

Accumulators should always be charged up every four weeks whether they have been used or not. It is a good plan to discharge the spare one through a 12-volt lamp for a few hours before re-charging. Always keep the top of the plates covered with acid; replace with new any that may be spilled, but on no account should fresh acid be used to replace any that may be lost through evaporation; only add distilled water, or sulphating will result.

Remember that all extra lights or other electrical fittings make an additional demand on the battery.

The Petrol Feed

Petrol Tank The petrol tank has a capacity of 20 gallons, and the petrol is fed to the carburettor by means of an autovac, located on the dash. Information regarding this system is contained in the Autovac booklet.

Carburettors Zenith Carburettors are fitted as standard to all models. Detailed information regarding the carburettor is contained in the Carburettor Handbook.

Universal Joint

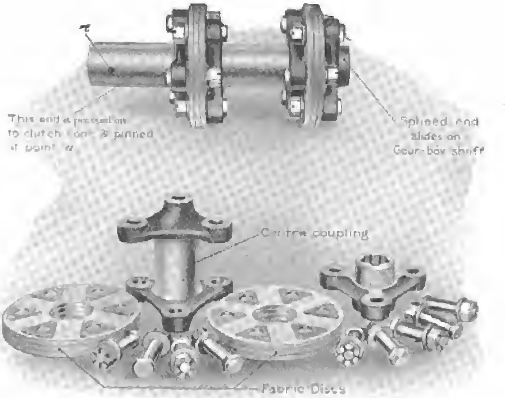

a
This end is pressed on to clutch cone & pinned at point a
Splined end slides on Gear-box shaft
Centre coupling
Fabric Discs

Fig. 14.—Fabric Disc Universal Joint, Assembled and Dismantled, as fitted between Clutch and Gearbox.

When detaching, it is unnecessary to remove both fabrics; by taking out the 6 bolts on the Gearbox end of the joint and 3 bolts on the forward end, one fabric may be left in position.

Front Wheel Hub and Steering Swivel

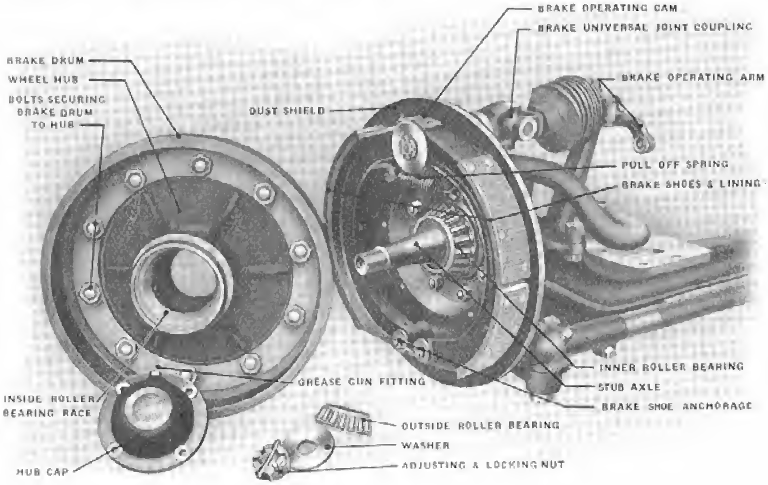


Fig. 15.

The Front Wheel Hub runs on roller bearings, and strict attention must be paid to see that it is well lubricated at regular intervals.

The Steering Swivel moves on a combined roller and thrust bearing and plain vertical pin. Pressure-gun nipples are provided at top and bottom of these pins, and grooves are arranged to convey the oil to the various parts. These, together with all ball steering joints, must be carefully attended to, and on no account allowed to be short of sufficient lubricant.

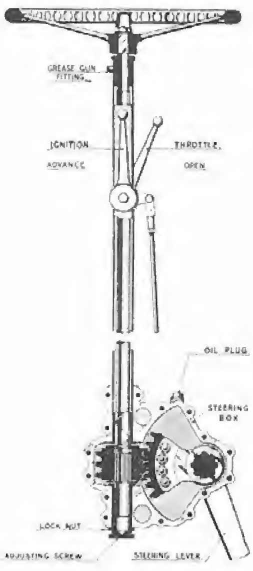


Fig. 16.

Steering Gear

Importance of Lubrication The steering gear is of the "worm and segment" type. Great care should be taken to see that the proper lubrication of all parts is not neglected. At the top of the pillar will be found a small but important grease lubricator, which should be regularly attended to. The steering gear box must be supplied with gear oil through the plug hole provided for the purpose. In addition, the numerous grease lubricators fitted to the steering connections and axle swivel must also be kept well supplied.

While attending to these instructions a careful inspection of all nuts and connections should be made; see that none are loose, and that all split pins are in position.

Remember that the steering is the most vital part of the machine.

The Dennis Patent Multi-stage Turbine Pump

(Protected by Royal Letters Patent, No. 146208 of 1921)

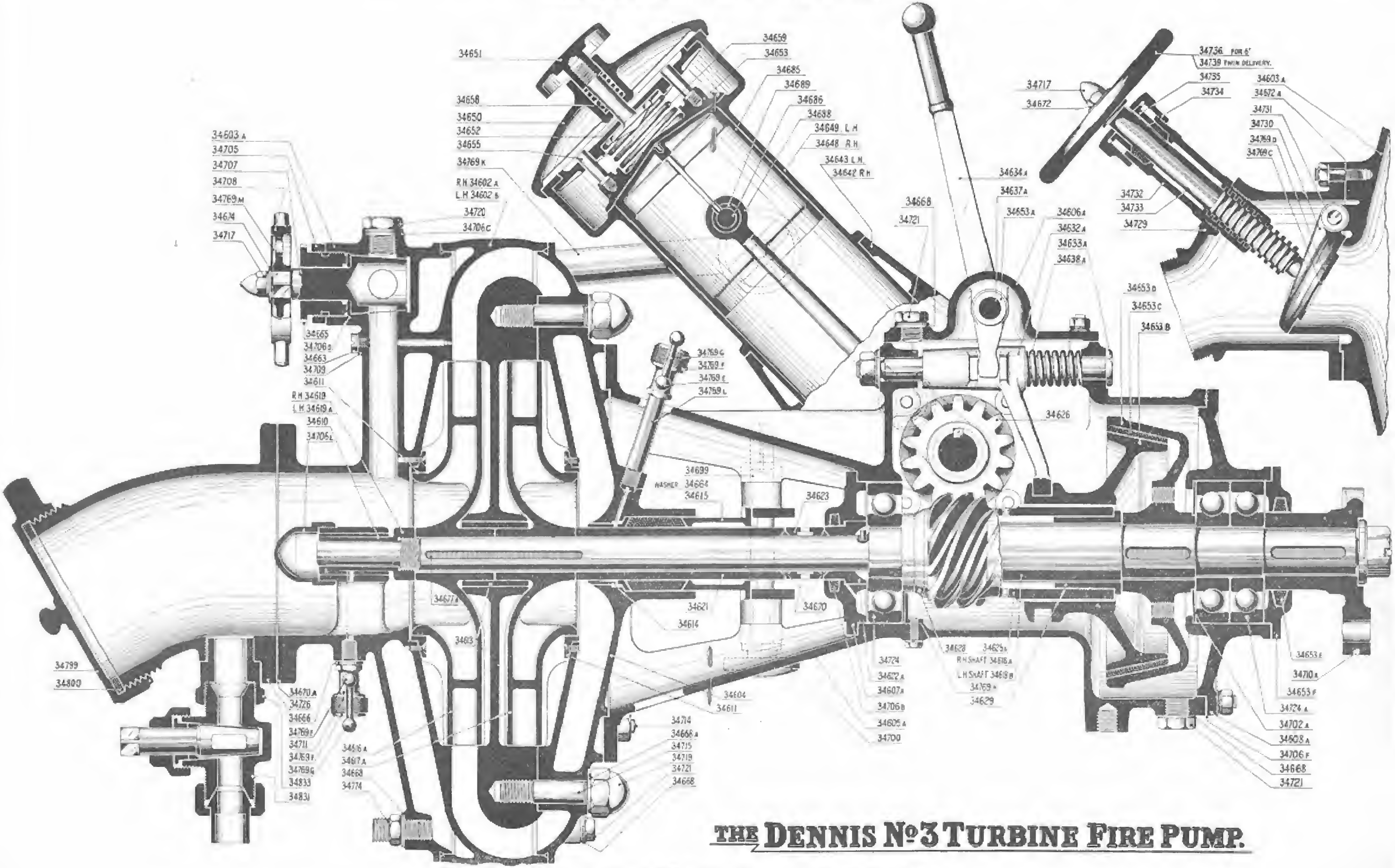


Fig. 17.—Sectional View of Dennis Patent Turbine Fire Pump.

When ordering replacements, quote the code number of the part, as shown above, together with the chassis number. It is also desirable to give a short description.

Description of Gearbox and Change-Speed Mechanism

The gearbox is of the four-speed and reverse sliding pinion type, with direct drive on fourth gear. Ball bearings are used throughout, and all wheels are mounted on splined shafts. A careful study of the line-drawing should be made, so that the functions of the various parts may be understood.

Lubrication Gear oil, such as Ilo Gear Oil or Vacuum C, is the best lubricant for both these boxes. All that is required is that the wheels just touch the oil, which should never be less than 1¾ inches from the bottom of the splined shaft. Oil working out of the breather on gearbox cover is due to too much oil.

The Gate Change The various positions of the hand lever for the four forward speeds and reverse are clearly marked. It is most essential to keep all the moving parts of the change-speed operating mechanism well lubricated and working freely.

Gear Changing

Clutch-Stop The first essential point in gear changing is to note that the clutch has plenty of downward movement, and that the clutch-stop pad comes into operation before the pedal plate reaches the footboard.

Starting Away To engage First Gear or Reverse, the throttle lever should be moved back. Then, fully depress the clutch pedal and wait a second for the male portion to stop spinning. The gear lever should then be pushed forward into the first-gear notch.

" Changing Up " Before changing from first to second gear, the engine should be run moderately fast on first gear. Then de-clutch, and move lever to neutral, pause a second, and finally bring the lever into second gear.

In changing to the third and fourth gears this operation will be repeated except that from second to third gear no pause should be made because of the extra time taken for the lever to traverse the gate.

" Changing Down " In changing down, the clutch pedal should be slightly depressed, and the gear lever moved to the neutral position. The clutch should then be re-engaged for a second, and at the same time the engine slightly accelerated; the clutch pedal should again be depressed, the gear lever being slipped into the lower gear with the last clutch movement. This is known as "double clutching," the object being to speed up the male portion, making the ratio of speeds correct for the engagement of the lower gear.

" Double Clutching "

A point to bear in mind is that the clutch cone should not stop spinning too quickly. Should this be the case, the stop should be adjusted a little further away, and a little grease put on the pad.

Pump Gearbox

The Pump gearbox is built in a single unit with the gearbox and consists of an aluminium casing containing ground gear wheels. The drive is taken from the constant wheels in the gearbox so that the lubrication of this pump box is automatically carried out so long as the gearbox has the correct amount of oil.

Dennis Fire Engine Gearbox

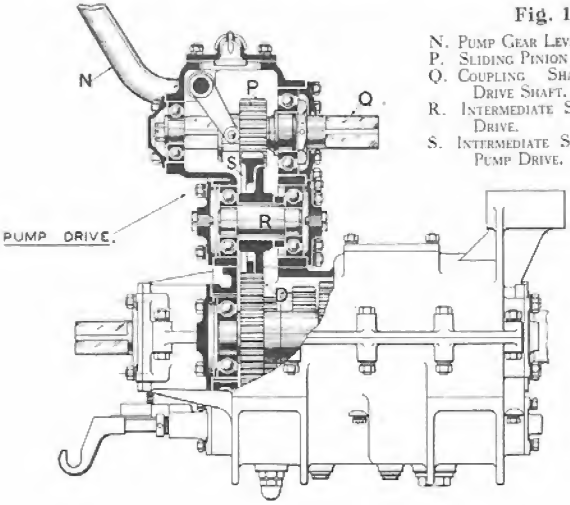


Fig. 18.

N. Pump Gear Lever.
P. Sliding Pinion for Pump Drive.
Q. Coupling Shaft to Pump Drive Shaft.
R. Intermediate Shaft for Pump Drive.
S. Intermediate Shaft Wheel for Pump Drive.

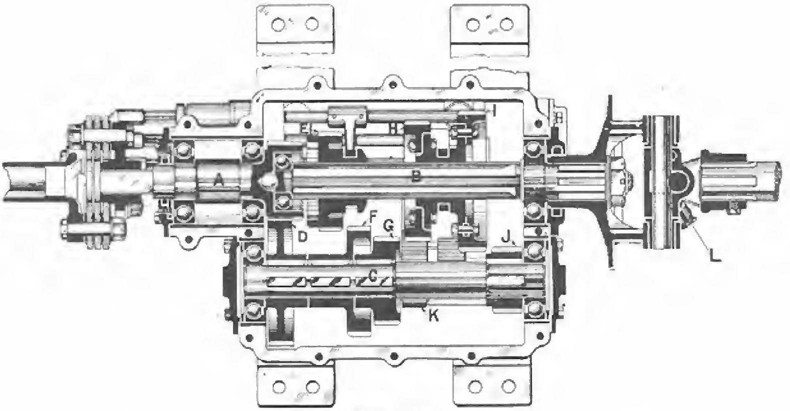


Fig. 19.

A. First Motion Shaft.
B. Main Shaft.
C. Secondary Shaft.
D. Constant-Mesh Wheel.
E. Third Speed Wheel.
F. Third Speed Wheel Pinion on Secondary Shaft.
G. 2nd Speed Pinion on Secondary Shaft.
H. 2nd Speed Wheel on Main Shaft.
I. 1st Speed Wheel on Main Shaft.
J. 1st Speed Pinion on Secondary Shaft.
K. Idle Wheel for Reverse.
L. U.V. Joint Pressure-Gun Nipple.

Dennis Worm-Driven Rear Axle

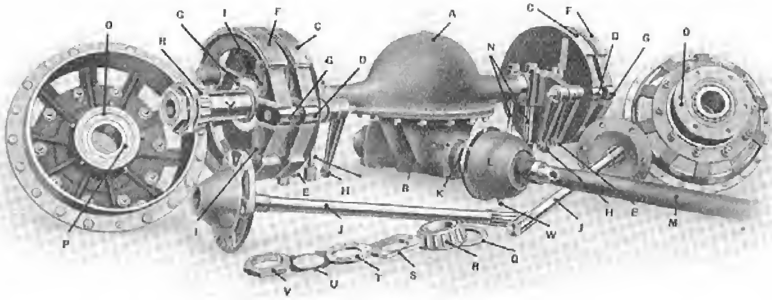


Fig 20.—Hubs, Rear Brakes, Live Axles, Wheel Bearings, and Propeller Shaft Drive.

A. Top Axle Case carrying Extension Tubes "Y" for Rear Wheels and Brake Brackets.
B. Detachable Base carrying Worm Shaft, Worm Wheel and Differential.
C. Servo-operated Brake Shoes.
D. Cams operating Servo Brake Shoes.
E. Levers operating Servo Brake Shoes.
F. Hand-operated Brake Shoes.
G. Cams operating Hand-Brake Shoes.
H. Levers operating Hand-Brake Shoes.
I. Brake Shoes "Pull-off" Springs.
J. Live Axle Shafts and Rear Wheel Driving Plates.
K. Adjustable Oil - Retaining Collar.
L. Universal Joints and Cover.
M. Propeller Shaft.
N. Spring Clip Bolts.
O. Rear Hubs and Brake Drums combined.
P. Inner Roller Bearings.
Q. Felt Oil-Retaining Washer.
R. Outer Roller Bearing.
S. Rear Roller Bearing Adjusting Nut.
T. Spaced Locking Ring for Adjusting Nut "S."
U. Locking Washer for Lock Nut "V."
V. Rear Wheel Lock Nut.
W. Pressure-Gun Nipple.

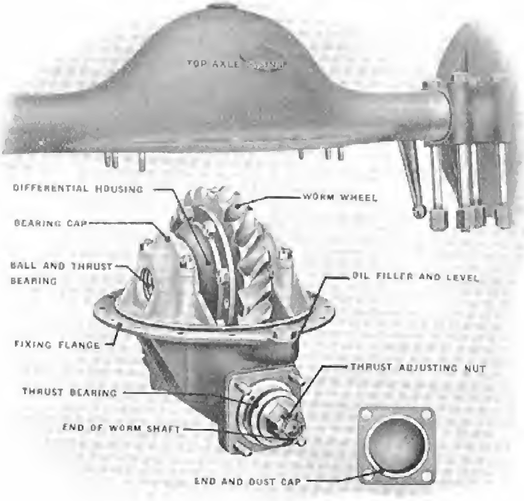


Fig. 21.—The Back Axle Partly Dismantled.

To dismantle Axle, remove Hub Caps, together with Live Axle Shafts. Then disconnect Propeller Shaft at Universal Joint Couplings and loosen nuts on Flange connection on underside of Worm-Casing. The bottom half of the Axle, with the Worm Gearing, can then be lowered to the ground.

The rear axle is of the worm and wheel-driven type, and a study of the photographs, together with the line drawings, will make the details quite clear. It will be noticed that on the withdrawal of the " Live " axles by means of the bolts holding the driving plate to the road wheels, the worm and wheel, complete with differential gear, can be dropped as one unit.

Overhauling Should it be necessary to take any of the gearing to pieces, great care must be taken to see that the parts are correctly reassembled, careful attention being paid to the mounting of the worm and wheel, seeing that the parts are central and in line, and that the worm takes its proper bearing on the worm wheel. Also see that there is no " end play " in any of the thrust bearings—these must be adjusted to eliminate this.

Lubrication and Attention Remove filler cap "N about every two weeks and replenish if necessary, using a mixture of Gear and Lubricating Oil ; make sure that lubricant used is perfectly clean and free from grit or dirt. After the first 1,000 miles the axle should be drained by means of the plug provided, the inspection cover removed and axle flushed through with paraffin, replenishing with entirely new lubricant until visible in filler " N." It should receive similar attention approximately every twelve months. Do not forget to tighten the drain plug " H " thoroughly.

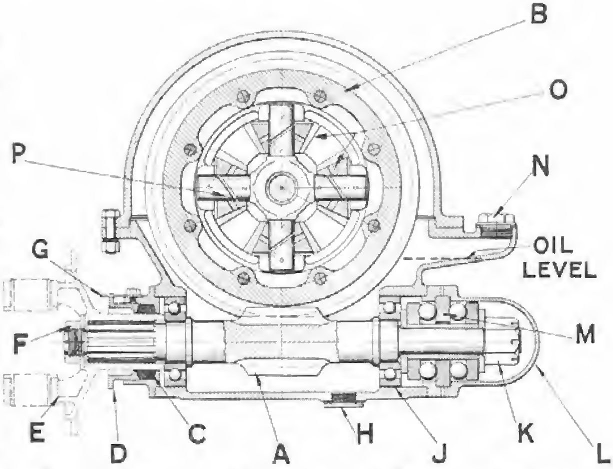


Fig. 22.—Sectional View through Worm and Wheel.

A. Worm Shaft.
B. Worm Wheel.
C. Felt Oil Retaining Washer.
D. Packing Gland Nut.
E. Universal Joint.
F. Universal Joint Lock Nut.
G. Packing Gland Locking Plate.
H. Drain Plug.
J. Worm Shaft Journal Bearing.
K. Thrust Adjusting Nut.
L. Thrust Bearing Cap.
M. Thrust Bearing.
N. Oil Filling Plug.
O. Differential Pinions.
P. Differential Pinion Star.

The Brakes

Foot Brake The pedal operates through a vacuum-servo to all four wheels. Instructions for the maintenance of the vacuum-servo are contained in a separate booklet. The Master adjustment for the four-wheel brakes is placed behind the servo mechanism on the 4-cylinder machine, and in front of the servo on the 6-cylinder.

The brake on each wheel has a separate adjustment, and it is advisable to jack up all four wheels occasionally and check each wheel for adjustment in relation to the others, bearing in mind that it is advisable for the rear brakes to have a slight lead.

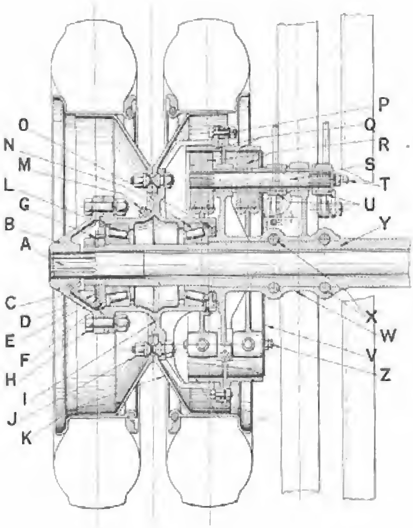


Fig. 23.—Sectional Plan View of Rear Wheel.

A. Live Axle Shaft.
B. Hub Cap and Wheel Driving Plate.
C. Lock Nut.
D. Nut Locking Washer.
E. Index Plate.
F. Adjusting Nut.
G. Index Pin.
H. Hub Cap Bolts.
I. Wheel Hub.
J. Disc Wheel Clamping Nuts.
K. Wheel Discs.
L. Outer Roller Bearing.
M. Tecalemit Greaser.
N. Inner Roller Bearing.
O. Felt Washer.
P. Brake Drum Bolts.
Q. Brake Drums.
R. Brake Cams.
S. Brake Cam Shaft.
T. Tecalemit Greaser.
U. Brake Levers.
V. Dust Shield.
W. Spring and Brake Bracket.
X. Road Spring Bolts.
Y. Axle Extension.
Z. Tecalemit Greaser.

Hand Brakes The Master adjustment for the hand brake is placed at the near side of the gearbox on the 4-cylinder model, and outside the frame, close to the brake lever, on the 6-cylinder. Each brake has also a separate adjustment on the brake pull-on rod.

The adjustment of these brakes should also be checked occasionally.

Brake Gear Lubrication Pressure-gun nipples are fitted to the brake cross-shaft bracket bearings, brake arms and pivots, and these should receive frequent attention with the pressure-gun, also all knuckle joints and the rods should be kept well lubricated. A rusty or tight knuckle joint might readily cause a rod to break.

The importance of the above will be realized when it is remembered that, next to the steering, the brakes are the most important part of the machine.

Universal Joints Special attention should be paid to the lubrication of all the Universal Joints on the driving shafts, especially on the propeller shaft.

Road Wheels Both front and rear road wheels run on taper roller bearings, which should be inspected from time to time to guard against excessive side-play. When re-adjustment is required, it should be carried out as follows :—(1) Jack up axle. (2) Remove hub cap. (3) Unscrew hexagonal locking nut after flattening locking washer. (4) Ease off perforated washer. (5) Screw up adjusting plate, **barely sufficiently to take the side movement** out of the wheel. **Undue tightening** of this plate will cause **serious damage** to the rollers ; **leave it on the slack side.** Then replace perforated washer, registering the pin of the locking washer, fully tighten lock nut, and set over locking washer to hold it securely. Finally, replace hub cap.

The Dennis Patent Multi-stage Turbine Pump

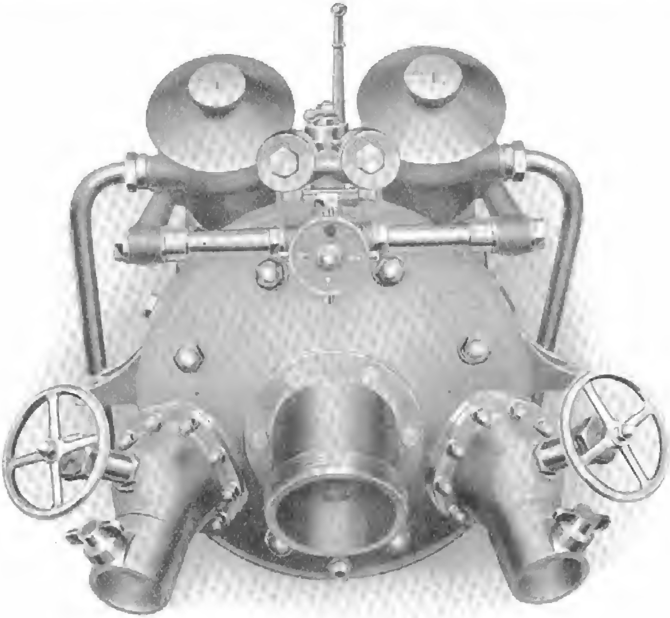


Fig. 24.—View of the Dennis Multi-stage Turbine Pump, showing suction inlet and the deliveries. Note the 3-way rotary valve in the priming position.

The Dennis Pump is a two-stage back-to-back high-pressure Turbine made entirely of gunmetal, and is very simple in construction. It is driven through a Hardy disc joint which allows a certain amount of universal action.

The water enters the pump through the suction direct into the eye of the first impeller and from there through passages in the diffuser ring to the eye of the second impeller, and then through alternate passages in the diffuser ring again, to the deliveries.

Two grease cups are provided for lubrication ; one is on the back cover of the pump underneath the suction adaptor, the other on the front cover between the air pumps. Both of these are for the purpose of lubricating the pump spindle. The only other lubrication that is required, but it is very important, is a small amount of engine oil and grease for the air pump clutch which is poured into clutch operating box by unscrewing the four cap nuts and removing the lid. Also there are two inspection covers on the air pump crank cases. These should be kept full of engine oil up to the baffle. The big ends of the connecting rods are kept lubricated by this means. When checking the oil-level in the crank-pits, drain off any water by means of the drain-cocks, after allowing time for the water and oil to separate. The correct level reading can then be obtained.

After a working-job, take out the spring-loaded exhaust valves in the top of the cylinders, and smear a little light grease round the inside of the cylinder barrels.

The Dennis Patent Multi-stage Turbine Pump—*continued*

Instructions for Getting the Pump to Work First see that the suction is screwed tight after having made sure that the leather washer is in position.

See that the copper strainer is well under the water. On no account should the pump be run unless the strainer is screwed on to the last length of suction, as there is a possibility of stones, etc., being drawn up into the pump and so choking the water passages.

Connect up the delivery hose and open up whichever outlet is first going to be used.

Start up the engine and run it quite slowly. See that the rotary three-way valve on the back of the pump cover has the arrows in this position, $\overset{\longleftrightarrow}{\downarrow}$ namely, one pointing downwards to the suction, the other two across the pump pointing to each of the air pumps.

Then pull the small lever between the air pumps towards you. This actuates the air pump clutch and the air pumps will then start exhausting. (The air pumps should not be run at a higher speed than 250 to 300 revolutions per minute.) Hold the clutch lever in until the pump has picked up its water. Then push the lever away from you and turn the rotary valve half a turn, bringing the arrows into this position $\underset{\longleftrightarrow}{\uparrow}$ cutting out all connections between the air pumps and the turbine.

Operate the throttle to speed the engine up to give the required pump pressure.

Always run with the ignition lever fully advanced when pumping, but always ensure that it is well retarded when starting up the engine.

After the engine has been running a short time and has got thoroughly warmed up, the temperature can be controlled by the cock on the filter which allows cold water to enter the radiator from the pump head and run out at the overflow pipe. The correct temperature should be about 150° to 170°F.

If it is required to stop pumping for a short time there is no need to shut down the whole plant. Simply reduce the engine speed until it gives about 20 to 30 lb. pressure on the pump gauge, and then screw down your delivery valve. This will not damage the pump in any way, and for this reason control branches can be used with a turbine pump.

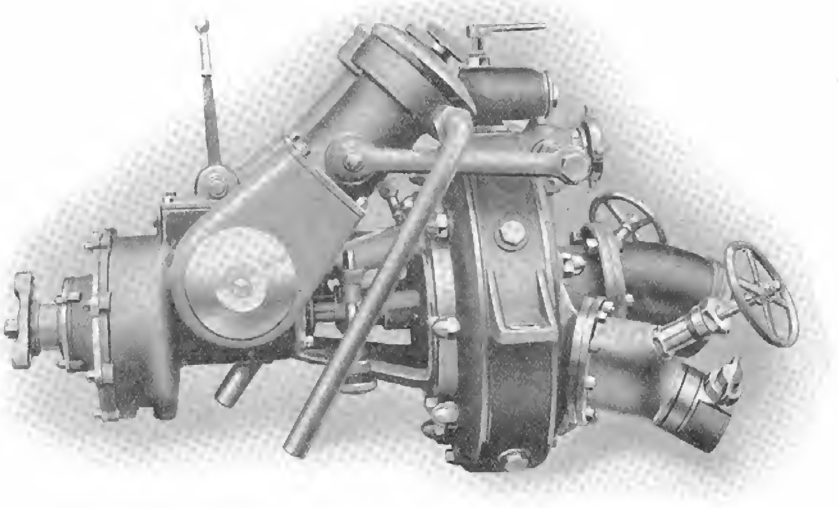


Fig. 25.—Broadside view of the Pump.

A Few Hints and Tips—*continued*

Stoppage of Vehicle or Engine on the road may be due to :

1. Petrol supply choked.
2. Switch accidentally knocked " Off."
3. Petrol tap jolted closed.
4. Petrol finished.
5. Over-heating through lack of lubrication to the various bearings.
6. Brakes adjusted too tight.
7. Bell-crank of contact-breaker seized in fibre bush, see " Contact-Breaker"—Magneto notes, page 13.

Engine will not start

If the petrol feeds to the float chamber satisfactorily and engine will not start, it may be due to :—

1. Choked petrol jet.
2. Throttle insufficiently open.
3. Coil ignition not working.
4. Switch not being on.
5. Throttle too far open.
6. Sparking plug points too far apart. See notes under " IGNITION."

Engine will not accelerate

This may be due to :—

1. Ignition being too far retarded.
2. Contact-breaker points of magneto dirty and out of adjustment. See note under " IGNITION."
3. One or more sparking plugs misfiring. These should be checked occasionally ; to do this, start engine and short-circuit each sparking plug in turn. A variation in the engine rate should be observed if the cylinder under test is firing correctly. If the plug proves, on inspection, to be sound, look to the valves. One of them may have insufficient tappet-clearance, which prevents it from seating properly, or a tappet may have become slack and worked down.

Explosions in Silencer

This is probably due to faulty ignition. Check firing.

Over-heating

1. Insufficient water in radiator.
2. Fan belt loose.
3. Unnecessary running of machine on the lower gears.
4. Engine short of oil.
5. Tappets badly adjusted, not allowing valves to close.
6. Ignition too far retarded.
7. Clutch slipping.
8. Carburation difficulties, mixture probably being too strong.
9. Misfiring.
10. Water circulation at fault.

Engine knocking.

1. Ignition too far advanced. If ignition has been retarded and knocking still continues, it may be due to pre-ignition. In other words, the carbon deposit requires cleaning off the piston heads. Sometimes an engine will fail to stop when ignition has been switched off. This is also due to pre-ignition or self-ignition through over-heated sparking plug points.
2. Connecting rod or shaft bearings may be worn.
3. Misfiring on one or more cylinders.

A Few "Don'ts"

1. Do not open throttle fully or suddenly when engine is cold—always open gradually until the engine is thoroughly warmed up.
2. Do not forget to keep engine warm in the station, particularly during cold weather.
3. Do not fill the radiator when the engine is overheated. Always wait until the cylinders have cooled down, otherwise there is danger of damaging them.
4. Do not forget to keep the fan belt adjusted and driving properly.
5. Do not forget to switch on.
6. Do not forget to see that oil pressure indicator is registering when engine is running.
7. Do not let the magneto, wiring, sparking plugs or any part of ignition apparatus get damp.
8. Do not forget to run with the ignition as far advanced as possible. The engine will run cooler and the petrol consumption will be better.
9. Do not forget to use a really efficient strainer (preferably chamois leather) when filling up with petrol.
10. Do not forget to keep both the foot and hand brakes adjusted.
11. Do not forget that the hand brakes should hold when brake lever is half-way along quadrant, also that foot brake should hold well before pedal plate reaches the footboard.
12. Do not forget to lubricate the hubs of the rear wheels, front wheels, also rear axle, gearbox and universal joints.
13. Do not forget to lubricate every brake rod bearing, also all knuckle and ball joints throughout the vehicle—this is essential.
14. Do not forget to lubricate the steering swivel pins, also shackle pins of all springs.
15. Do not forget to lubricate the steering box.
16. Do not forget to check the compression of each cylinder occasionally, to see that it is doing its fair share of work.
17. Do not tamper with any part of the vehicle unnecessarily.
18. Do not forget that the general performance of a motor vehicle depends largely on the attention given to it by the driver.
19. Do not forget to keep the engine, gearbox and undershield thoroughly clean.
20. Do not forget to re-set the electrodes of the sparking plugs after every 50 hours' running.
21. Do not forget to check the adjustment of the brakes periodically.
22. Do not open throttle too far or engine will not start.
23. Do not forget to keep a small quantity of engine oil in the air pump clutch-operating box.

When at a Working Job

1. Make quite sure the suction unions are air-tight, and that the suction strainer is at least 6 in. under the surface of the water.

2. If the water contains leaves or any floating matter, use a basket strainer over the copper one or the holes in the latter will get filled up. You will be able to see by looking at the **vacuum gauge** if this is happening ; should the holes in the strainer get filled with dirt, the vacuum reading increases—when this is noted the strainer should be cleaned at once.

3. When working out of a dam keep the strainer right at the bottom, strap it there if possible, and do not let the feeds flow in on the surface—tie the coupling under the surface also. Keep the water just overflowing all the time you are working.

4. When working with a collecting head, care must be taken not to " **over-run** " the water supply. Keep a sharp look-out on the **compound vacuum gauge;** this will tell you what is happening. If pressure is shown, you can open the throttle a little more—if more pressure is required on the delivery valves, keep your eye on the gauge at the same time. Do not go past the **zero** on to the vacuum side when feeding with canvas hose, or you will draw it flat, and at the same time draw air through the hose, spoiling the jet. Close up throttle a little until compound gauge shows a little pressure. If the delivery pressure is insufficient, it will be necessary to use a smaller nozzle, as the water supply is not enough for the larger one.

5. When using the direct suction connection, make sure the stand pipe is a good fit to hydrant and air-tight. Connect up suction with direct adapter on the end to the stand pipe, open up delivery valve, and then turn hydrant on **full.** Put the pump gear " IN " in the usual way, and open throttle slowly, ensuring that the vacuum gauge never gets to more than 10 in. of vacuum. **Of course, when using the collecting head or direct suction, you will not require the air pumps.**

6. If the cooling water through the radiator overflow gets less, turn lever on the twin filter to the other side, and clean the choked gauze. It is not necessary to slow the pump while doing this.

7. Keep a good look-out for the engine oil—**see that the indicator is recording properly** and that there is plenty of oil. When you have a long pumping job it is best to put a little oil in at a time.

8. Run on the magneto ignition when pumping—keeping it fully advanced.

9. Do not run with the pump gland too tight—have it slack enough to let a little water run through.